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Higgs-mass predictions

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Abstract

A compilation of Higgs-mass predictions is proposed.

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1 Introduction

Many physicists hope that the electro-weak Higgs scalar will be observed within a few years at the LHC or at the Tevatron. The literature contains a plethora of predictions or upper limits of the Higgs mass based on many different ideas, models and calculational techniques. Privileged among them is the value $m_H = 150 \pm 36$ GeV currently given by the LEP Electroweak Working Group, because it only relies on precision electro-weak data, non-observation of the Higgs today and the minimal hypothesis that the standard model is correct as it stands. A compilation of all other predictions is attempted here. Some models make additional predictions or postdictions, that are indicated. The point in time separating pre- and postdiction is taken as the time of publication of the model. In this task it is unavoidable that I will miss some references. I beg their authors' pardon and would like to ask them to kindly drop me a mail. Also some of the older pre- and postdictions might need an update due to changed experimental values of e.g. the top-mass, gauge couplings,... I would be happy to receive and to include such updates.

The predictions are organised in increasing order of the central value of the predicted mass interval. In a second section the upper limits are presented in increasing order as well. A third section contains a single lower limit. Older predictions and limits incompatible with today's experimental lower limit of 114 GeV are not recorded here. However, I should mention the supersymmetric model by Dermíšek & Gunion (2005) with a Higgs mass of 100 GeV. Because of exotic decay channels this model is still compatible with LEP data. Also not recorded are predictions that come with postdictions contradicting present experimental numbers.

The references are in alphabetical order of the first author's last name with chronology as secondary criterion.

2 Predictions

- $m_H = 109 \pm 12$ GeV

Authors: O. Buchmüller *et al.* (2007)
Idea: constrained minimal supersymmetric standard model combined with electro-weak precision data, flavor physics and abundance of cold dark matter
Techniques: multi-parameter fit, renormalisation group equation. The top mass is taken to be $m_t = 170.9 \pm 1.8$ GeV.
Other predictions: many supersymmetric particles

- $m_H = 115.3 \pm 0.1$ GeV

Author: Schücking (2007)
Idea: interpretation of the $SU(2) \times U(1)$ group of the electro-weak forces as symmetry group of the Eguchi-Hanson metric
Techniques: differential geometry and quaternions

- $m_H = 117 \pm 4$ GeV

Authors: Gogoladze, Okada & Shafi (2007)
Idea: Higgs boson as zero mode of gauge boson along a fifth compactified dimension

Techniques: a boundary condition on the Higgs self-coupling at compactification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^8$ GeV

• $m_H = 118$
Authors: Arbuzov, Barbashov, Pervushin, Shuvalov & Zakharov (2008)
Idea: Three peaks of the cosmic microwave background are explained by the decay of primordial Higgs-, W- and Z-bosons into photons.
Techniques: conformal cosmology
Other prediction: $m_H = 216$

• $m_H = 120 \pm 6$ GeV
Authors: Ellis, Nanopoulos, Olive & Santoso (2005)
Idea: supersymmetry
Techniques: minimal supersymmetric extension of the standard model with universal soft supersymmetry-breaking masses
Other predictions: many supersymmetric particles

• $m_H = 121 \pm 6$ GeV
Authors: Feldstein, Hall & Watari (2006)
Idea: superstring inspired landscape of vacua and some probability density for the parameters of the Higgs potential
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{19}$ GeV
Postdiction: $m_t = 176 \ \pm 2$ GeV

• $m_H = 121.8 \pm 11$ GeV
Authors: Froggatt & Nielsen (1995)
Idea: two approximately degenerate vacua, one in which we live, the other of Planck energy
Techniques: renormalisation group equations
Postdiction: $m_t = 173 \ \pm 4$ GeV

• $m_H = 122 \pm 10$ GeV
Authors: Djouadi, Heinemeyer, Mondragon & Zoupanos (2004)
Idea: a supersymmetric version of $SU(5)$
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles
Postdictions: $m_t = 174 - 183$ GeV

• $m_H = 123.5 \pm 5.5$ GeV
Authors: Heinemeyer, M. Mondragon & G. Zoupanos (2007)
Idea: a supersymmetric Grand Unified Theory that ca be made all-loop finite
Techniques: renormalisation group flow with $m_t = 170.9$ GeV
Other predictions: supersymmetric particles
• $m_H = 124 \pm 21$ GeV
Authors: Barger, Deshpande, Jiang, Langacker & Li (2007)
Idea: supersymmetry broken at $10^5 - 10^{16}$ GeV and gauge coupling unification at $\Lambda \sim 10^{16} - 10^{17}$ GeV
Techniques: renormalisation group flow up to energies of Λ

Other predictions: new vector-like fermions with masses in the 200 - 1000 GeV range

- $m_H = 124 \pm 10$ GeV
Authors: Arbuzov, Glinka, Lednicky & Pervushin (2007), version 6
Idea: condensates, conformal cosmology
Techniques: Coleman-Weinberg potential
Other predictions: $m_H = 275 \pm 25$ GeV, version 1

- $m_H = 124.2 \pm 13.2$ GeV
Authors: Codoban, Jurcisin & Kazakov (1999)
Idea: supersymmetry
Techniques: minimal supersymmetric extension of the standard model with non-universal soft supersymmetry-breaking masses
Other predictions: many supersymmetric particles

- $m_H = 125 \pm 4$ GeV
Authors: Gogoladze, Okada & Shafi (2007)
Idea: Higgs boson as zero mode of gauge boson along a fifth compactified dimension
Techniques: a boundary condition on the Higgs self-coupling at compactification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{13} - 10^{14}$ GeV.

- $m_H = 126.3 \pm 2.2$ GeV
Authors: Shaposhnikov & C. Wetterich (2009)
Idea: Assume that gravity is asymptotically safe, that there are no intermediate energy scales between the Fermi and Planck scales, that the gravity induced anomalous dimension of the Higgs selfcoupling is positive.
Techniques: renormalisation group flow with $m_t = 171.2$ GeV

- $m_H = 127.5 \pm 7.5$ GeV
Authors: Chankowski, Falkowski, Pokorski & Wagner (2004)
Idea: supersymmetry and the Higgs as a pseudo-Goldstone boson of some extra global symmetry
Techniques: smaller fine-tuning than in the minimal supersymmetric extension of the standard model. The computation of the Higgs mass depends on the top mass taken to be $m_t = 178 \pm 4.3$ GeV.
Other predictions: many supersymmetric particles and an additional Z-boson with a mass of 3 TeV

- $m_H = 129.6$ GeV
Authors: X. Calmet & H. Fritzsch (2001)
Idea: confining $SU(2)$ and a 'complementarity principle'
Techniques: 1-loop corrections

- $m_H = 130 \pm 6$ GeV
Authors: Dae Sung Hwang, Chang-Yeong Lee & Ne'eman (1996)
Idea: embedding of the electro-weak Lie algebra $su(2) \oplus u(1)$ in the superalgebra $su(2|1)$
Techniques: renormalisation group flow
Postdictions: $\sin^2 \theta_w = 0.229 \pm 0.005$

- $m_H = 131 \pm 10$ GeV

Authors: Gogoladze, Li, Senoguz & Shafi (2006)
Idea: 7 dimensional orbifold with $SU(7)$ grand unification and split supersymmetry
Techniques: a boundary condition on the Higgs self-coupling at unification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: $m_H = 146 \pm 8$ GeV

- $m_H = 134 \pm 9$ GeV

Authors: Ni, Lou, Lu & Yang (1998)
Idea: a Gaußian effective potential
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{15}$ GeV

- $m_H = 135 \pm 6$ GeV

Authors: Gogoladze, Li & Shafi (2006)
Idea: 7 dimensional $N = 1$ supersymmetric orbifold with $SU(7)$ grand unification
Techniques: a boundary condition on the Higgs self-coupling at unification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: $m_H = 144 \pm 4$ GeV

- $m_H = 135 \pm 15$ GeV

Authors: Arkani-Hamed & Dimopoulos (2004)
Idea: split supersymmetry
Techniques: fine tuning and renormalisation group flow up to energies of 10^{16} GeV

- $m_H = 137 \pm 23$ GeV

Authors: Medina, Shah & Wagner (2007)
Idea: a warped fifth dimension and an extension of the electro-weak gauge symmetry to $SO(5) \times U(1)$ in the bulk, broken at the boundaries
Techniques: Coleman-Weinberg potential

- $m_H = 140 \pm 10$ GeV

Authors: Babu, Gogoladze, Rehman & Shafi (2008)
Idea: minimal supersymmetric extension of the standard model plus complete vectorlike multiplets of grand unified groups
Techniques: some fine tuning and renormalisation group flow up to energies of 10^{16} GeV. The top mass is taken to be $m_t = 172.6 \pm 1.4$ GeV.
Other predictions: many supersymmetric particles

- $m_H = 141 \pm 2$ GeV

Authors: Hall & Y. Nomura (2009)
Idea: minimal supersymmetric extension of the standard model plus supersymmetry breaking at very high scale, motivated from a multiverse
Techniques: huge fine tuning and 2-loop corrections with a top mass of 173.1 GeV
Other predictions: no supersymmetric particles

- $m_H = 143 \pm 37$ GeV

Authors: Cabibbo, Maiani, Parisi & Petronzio (1979)
Idea: the big desert: no new particles besides the Higgs and validity of perturbative

quantum field theory up to the Planck scale
Techniques: renormalisation group flow up to energies of 10^{19} GeV. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 171.5 \pm 2$ GeV.

- $m_H = 143.2 \pm 28.8$ GeV

Authors: Gogoladze, Okada & Shafi (2007.2)
Idea: 2 extra dimensions compactified on an orbifold
Techniques: a boundary condition on the Higgs self-coupling at compactification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{19}$ GeV.

- $m_H = 144 \pm 4$ GeV

Authors: Gogoladze, Li & Shafi (2006)
Idea: 7 dimensional $N = 1$ supersymmetric orbifold with $SU(7)$ grand unification
Techniques: a boundary condition on the Higgs self-coupling at unification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV.
Other predictions: $m_H = 135 \pm 6$ GeV

- $m_H = 145 \pm 7$ GeV

Author: Liu (2005)
Idea: supersymmetry broken at 10^{11} GeV and a $\mathbb{Z}_3$ symmetry among generations
Techniques: radiative corrections

- $m_H = 146 \pm 8$ GeV

Authors: Gogoladze, Li, Senoguz & Shafi (2006)
Idea: 7 dimensional orbifold with $SU(7)$ grand unification and split supersymmetry
Techniques: a boundary condition on the Higgs self-coupling at unification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV.
Other predictions: $m_H = 131 \pm 10$ GeV

- $m_H = 146 \pm 19$ GeV

Authors: Barger, Jiang, Langacker & Li (2005)
Idea: supersymmetry broken at high scale and gauge coupling unification at $\Lambda \sim 10^{16} - 10^{17}$ GeV
Techniques: renormalisation group flow up to energies of Λ

- $m_H = 148.1 \pm 10.7$ GeV

Author: Popa (2009)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action with $m_t = 171.3$ GeV and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

- $\underline{m_H = 150 \pm 36 \text{ GeV}}$

Authors: The LEP Electroweak Working Group
Idea: non-observation of the Higgs and quantum corrections by Higgs loops to precision electro-weak data
Techniques: experiment and quantum field theory

- $m_H = 150 \pm 10$ GeV

Authors: Barger, Chiang, Jiang & Li (2004)
Idea: supersymmetry broken at 10^{11} GeV and Peccei-Quinn symmetry
Techniques: radiative corrections

- $m_H = 150 \pm 20$ GeV

Authors: Arvanitaki, Davis, Graham & Wacker (2004)
Idea: split supersymmetry
Techniques: fine tuning and renormalisation group flow up to energies of 10^{16} GeV

- $m_H = 150 \pm 50$ GeV

Authors: Bai, Fan & Han (2007)
Idea: supersymmetry and a long-lived metastable supersymmetry breaking vacuum
Techniques: little Higgs mechanism, 1-loop corrections
Other predictions: many supersymmetric particles plus new gauge bosons and electroweak triplets at 1 TeV

- $m_H = 150 \pm 24$ GeV

Authors: Shaposhnikov & C. Wetterich (2009)
Idea: Assume that gravity is asymptotically safe, that there are no intermediate energy scales between the Fermi and Planck scales.
Techniques: renormalisation group flow with $m_t = 171.2$ GeV

- $m_H = 153 \pm 3$ GeV

Author: Okumura (1997)
Idea: a vague variant of the Connes-Lott model
Techniques: 2-loop renormalisation group flow up to energies of 10^{13} GeV. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 171.5 \pm 2$ GeV.

- $m_H = 154 \pm 6$ GeV

Authors: Ananthanarayan & Pasupathy (2001)
Idea: weak dependence of the ratio between Higgs self-coupling and top Yukawa coupling squared on renormalisation scale
Techniques: 1- and 2-loop corrections

- $m_H = 155 \pm 8$ GeV

Author: Schrempp & Schrempp (1993)
Idea: A strongly infrared attractive line in the $m_t - m_H$ plane is found.
Techniques: 1-loop renormalization group equations

- $m_H = 160 \pm 8$ GeV

Authors: Roepstorff & Vehns (2000)
Idea: combining gauge and Yukawa interactions in one generalised Dirac operator
Techniques: superconnections
Postdictions: $m_t = 160 \pm 8$ GeV

- $m_H = 160 \pm 20$ GeV

Authors: Langacker, Paz, Wang & Yavin (2007)
Idea: an extension of the minimal supersymmetric extension of the standard model plus a hidden sector plus a Z' mediating supersymmetry breaking by couplings to the hidden

sector
Techniques: 2-loop corrections up to energies of $10^7 - 10^{11}$ GeV
Other predictions: many supersymmetric particles

- $m_H = 160 \pm 24.5$ GeV

Authors: Barvinsky, Kamenshchik, Kiefer, Starobinsky & Steinwachs (2009)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action to 1-loop with $m_t = 171$ GeV and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

- $m_H = 160 \pm 30$ GeV

Author: Bezrukov (2008)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

- $m_H = 160 \pm 34$ GeV

Authors: Bezrukov & Shaposhnikov (2009)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action to 2-loop with $m_t = 171.2$ GeV and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

- $m_H = 160.7 \pm 24$ GeV

Authors: Bezrukov, Magnin & Shaposhnikov (2008)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action to 1-loop with $m_t = 171$ GeV and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

- $m_H = 160.9 \pm 0.1$ GeV

Author: Ne'eman (1986)
Idea: embedding of the electro-weak Lie algebra $su(2) \oplus u(1)$ in the superalgebra $su(2|1)$
Techniques: classical field theory
Postdictions: $\sin^2 \theta_w = 1/4$

- $m_H = 161.8033989$ GeV

Author: El Naschie (2005)
Idea: E-infinity theory
Techniques: ?

- $m_H = 170 \pm 10$ GeV

Authors: Chamseddine & Connes (1996)
Idea: derivation of the standard model from gravity by generalising Riemannian to non-commutative geometry

Techniques: operator algebras, heat-kernel expansion and renormalisation group flow up to energies of $\Lambda \sim 10^{13} - 10^{17}$ GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 170.9 \pm 2.5$ GeV.
Other predictions: conceptual uncertainty in proper time measurements of $\Delta\tau \sim \hbar/\Lambda = 10^{-41} - 10^{-37}$ s
Postdictions: $m_W^2/(\cos^2\theta_w\, m_z^2) = 1$, gluons must be massless and must have pure vector-couplings, $m_t < 186.3$ GeV.

• $m_H = 177.5 \pm 7.5$ GeV
Authors: Antusch, Kersten, Lindner & Ratz (2002)
Idea: the Higgs as a composite particle from neutrino condensation
Techniques: seesaw mechanism, gap equation, renormalisation group flow up to the condensation scale $\Lambda = 10^{16}$ GeV

• $m_H = 182 \pm 4$ GeV
Author: Namsrai (1996)
Idea: Higgs mass from space-time curvature
Techniques: general relativity and solitons

• $m_H = 185 \pm 5$ GeV
Author: Schrempp & Schrempp (1986)
Idea: A largely unspecified strong interaction is assumed to soften the elastic scattering of longitudinally polarised W bosons.
Techniques: a superconvergence sum rule

• $m_H = 185.7 \pm 0.1$ GeV
Author: Trostel (1987)
Idea: a geometrisation of the Yukawa couplings
Techniques: spinor connections

• $m_H = 186 \pm 8$ GeV
Authors: Tolksdorf & Thumstädter (2006)
Idea: differential geometric unification of general relativity and the standard model
Techniques: generalised Dirac operators, heat kernel expansion and renormalisation group flow up to energies of $\Lambda \sim 10^{10}$ GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 174 \pm 3$ GeV.

• $m_H = 194 \pm 80$ GeV
Authors: García-Bellido, Figueroa & Rubio (2008)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background, lower limit from non-observation of the Higgs at LEP

• $m_H = 197.2 \pm 124.8$ GeV
Authors: Froggatt, Laperashvili, Nevzorov, Nielsen & Sher (2006)
Idea: non-supersymmetric extension of the standard model with two Higgs doublets and

the multiple point principle
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^4 - 10^{19}$ GeV
Other predictions: additional neutral and charged scalars with masses larger than 202.4 GeV

- $m_H = 200 \pm 20$ GeV

Authors: Froggatt, Nevzorov, Nielsen & Thompson (2008)
Idea: non-supersymmetric extension of the standard model with two Higgs doublets and the multiple point principle
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^5$ GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 171.4 \pm 2.1$ GeV.
Other predictions: enhanced top-Higgs coupling

- $m_H = 200 \pm 50$ GeV

Author: Cvetič (1995)
Idea: It is supposed that the 1-loop contributions of the scalar self-interactions to the effective potential are distinctly less than those of the Yukawa couplings of the top.
Techniques: 1-loop corrections with cut-off at 10^3 GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 180$ GeV.

- $m_H = 203 \pm 2.2$ GeV

Author: Squellari & Stephan (2007)
Idea: extension of Chamseddine and Connes' spectral action to include three vectorlike isospin doublets
Techniques: operator algebras, heat-kernel expansion and renormalisation group flow up to $\Lambda = 3 - 5 \cdot 10^7$ GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 170.9 \pm 2.6$ GeV.
Other predictions: six new leptons with masses of $10 - 550$ TeV, conceptual uncertainty in proper time measurements of $\Delta\tau \sim \hbar/\Lambda \sim 10^{-32}$ s
Postdictions: $m_W^2/(\cos^2\theta_w\, m_z^2) = 1$, gluons must be massless and must have pure vector-couplings.

- $m_H = 210 \pm 10$ GeV

Authors: Andrianov & Romanenko (1995)
Idea: modified Veltman condition and fixed point in running of Yukawa coupling
Techniques: renormalisation group flow up to energies of 10^{16} GeV
Postdictions: $m_t = 175 \pm 5$ GeV

- $m_H = 216$

Authors: Arbuzov, Barbashov, Pervushin, Shuvalov & Zakharov (2008)
Idea: Three peaks of the cosmic microwave background are explained by the decay of primordial Higgs-, W- and Z-bosons into photons.
Techniques: conformal cosmology
Other prediction: $m_H = 118$

- $m_H = 226 \pm 50$ GeV

Authors: Aranda, Díaz-Cruz & Rosado (2005)
Idea: unification of the weak gauge couplings at intermediate energy Λ and linear or

quadratic relation of these to the Higgs self-coupling
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{13}$ GeV

- $m_H = 241.2 \pm 1.6$ GeV

Author: Stephan (2007)
Idea: extension of Chamseddine and Connes' spectral action to $SU(4) \times SU(3) \times SU(2) \times U(1)$
Techniques: operator algebras, heat-kernel expansion and renormalisation group flow up to $\Lambda = 2 \cdot 10^4$ GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 170.9 \pm 2.6$ GeV.
Other predictions: confined $SU(4)$ singlets in the TeV range, conceptual uncertainty in proper time measurements of $\Delta\tau \sim \hbar/\Lambda = 3.3 \cdot 10^{-29}$ s
Postdictions: $m_W^2/(\cos^2\theta_w\, m_z^2) = 1$, gluons must be massless and must have pure vector-couplings.

- $m_H = 250 \pm 50$ GeV

Authors: Barbieri, Hall, Nomura & Rychkov (2006)
Idea: extending the minimal supersymmetric extension of the standard model by adding a chiral singlet with a superpotential interaction with the Higgs doublets
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10$ TeV

- $m_H \approx 250$ GeV

Authors: Ne'eman & Thierry Mieg (1982)
Idea: embedding of the electro-weak Lie algebra $su(2) \oplus u(1)$ in the superalgebra $su(2|1)$
Techniques: classical field theory
Postdictions: $\sin^2\theta_w = 1/4$

- $m_H = 255 \pm 145$ GeV

Author: Mahbubani (2004)
Idea: split supersymmetry
Techniques: fine tuning and renormalisation group flow up to energies of 10^{16} GeV

- $m_H = 271 \pm 5$ GeV

Authors: Connes & Lott (1991)
Idea: derivation of the Higgs sector of the standard model from the Yang-Mills sector by generalising Euclidean to noncommutative geometry
Techniques: operator algebras. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 170.9 \pm 2.5$ GeV.
Postdictions: $m_W^2/(\cos^2\theta_w\, m_z^2) = 1$, gluons must be massless and must have pure vector-couplings, $m_t > 139.3$ GeV, $\sin^2\theta_w < 0.543$.

- $m_H = 275 \pm 25$ GeV

Authors: Arbuzov, Glinka, Lednicky & Pervushin (2007), version 1
Idea: condensates, conformal cosmology
Techniques: Coleman-Weinberg potential
Other predictions: $m_H = 124 \pm 10$ GeV, version 6

- $m_H = 308.6 \pm 0.3$ GeV

Authors: López Castro & Pestieau (1995)
Idea: absence of quadratic and logarithmic divergences in the top mass
Techniques: 1-loop quantum corrections
Other predictions: $m_t = 170.5 \pm 0.3$ GeV

- $m_H = 309 \pm 6$ GeV
Authors: Decker & Pestieau (1979), also Veltman (1981)
Idea: absence of quadratic 1-loop divergences
Techniques: dimensional reduction. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 170.9 \pm 2.5$ GeV.

- $m_H = 317 \pm 80$ GeV
Authors: Bazzocchi & Fabbrichesi (2004)
Idea: Flavour symmetry broken together with electro-weak symmetry, little Higgs
Techniques: Coleman-Weinberg effective potential
Other predictions: Many new particles including a charged scalar with mass 560 ± 192 GeV

- $m_H = 374 \pm 6$ GeV
Author: Xiao-Gang He (2002)
Idea: no dependence of total vacuum energy (Casimir plus minimum of Higgs potential) on renormalisation scale
Techniques: Casimir effect and quantum corrections. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 170.9 \pm 2.5$ GeV.

- $m_H = 426$ GeV
Author: Fairlie (1979)
Idea: embedding of the electro-weak Lie algebra $su(2) \oplus u(1)$ in the superalgebra $su(2|1)$
Techniques: classical field theory
Postdictions: $\sin^2 \theta_w = 1/4$

- $m_H = 500 \pm 100$ GeV
Authors: Barbieri, Hall & Rychkov (2006)
Idea: adding an inert isospin doublet of pseudo scalars
Techniques: renormalisation group flow up to energies of $\Lambda \sim 1.5$ TeV
Other predictions: pseudo scalars with masses between 60 GeV and 1 TeV leading in particular to an increased width of the ordinary Higgs scalar

- $m_H = 515 \pm 64$ GeV
Authors: Langguth, Montvay & Weisz (1986)
Idea: lattice gauge theory and triviality of the continuum limit
Techniques: Monte Carlo simulations on 12^4 lattices

- $m_H = 536 \pm 10$ GeV
Authors: Babic, Guberina, Horvat & Stefancic (2001)
Idea: no dependence of cosmological constant on renormalisation scale
Techniques: quantum corrections. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 170.9 \pm 2.5$ GeV.

- $m_H = 760 \pm 21$ GeV

Authors: Cea, Consoli & Cosmai (2003)
Idea: lattice gauge theory and triviality of the continuum limit
Techniques: extrapolation from Ising limit

- $m_H = 1900 \pm 100$ GeV

Authors: Ibañez-Meier & Stevenson (1992)
Idea: vanishing bare Higgs mass and 1-loop effective potential
Techniques: autonomous renormalisation

- $m_H = 10^{18}$ GeV

Authors: Batakis & Kehagias (1991)
Idea: Higgs field as massive excitation of the vacuum configuration of a sigma field coupled to gravity
Techniques: non-linear sigma models

3 Upper bounds

- $m_H < 123$ GeV

Authors: Belyaev, Dar, Gogoladze, Mustafayev & Shafi (2007)
Idea: constrained minimal supersymmetric standard model combined with supersymmetry constraints from colliders and low energy physics and constraints on dark matter
Techniques: renormalisation group equation. The top mass is taken to be $m_t = 171.4$ GeV.
Other predictions: many supersymmetric particles

- $m_H < 125$ GeV

Authors: Froggatt, Nevzorov, Nielsen & Thompson (2008)
Idea: non-supersymmetric extension of the standard model with two Higgs doublets and the multiple point principle
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{10}$ GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 171.4 \pm 2.1$ GeV.

- $m_H < 125$ GeV

Authors: Babu, Gogoladze, Rehman & Shafi (2008)
Idea: minimal supersymmetric extension of the standard model plus complete vectorlike multiplets of grand unified groups
Techniques: some fine tuning and renormalisation group flow up to energies of 10^{16} GeV. The top mass is taken to be $m_t = 172.6 \pm 1.4$ GeV.
Other predictions: many supersymmetric particles

- $m_H < 126$ GeV

Authors: De Simone, Hertzberg & Wilczek (2008)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action to 2-loop with $m_t = 171.2$ GeV and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave

- $m_H < 127$ GeV

Authors: Carena, Nardini, Quiros & Wagner (2008)
Idea: minimal supersymmetric extension of the standard model with a light stop and electro-weak baryo-genesis
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: the light stop with mass < 120 GeV

- $m_H < 130$ GeV

Authors: Okada, Yamaguchi & Yanagida (1991)
Idea: minimal supersymmetric extension of the standard model
Techniques: soft supersymmetry breaking at 1 TeV and quantum corrections
Other predictions: many supersymmetric particles

- $m_H < 130$ GeV

Authors: Bento, Bertolami & Rosenfeld (2001)
Idea: introduction of a stable gauge singlet scalar of mass around 1 GeV coupled to the Higgs, playing the role of cold dark matter and solving problems with small scale structure formation
Techniques: phenomenological constraints from cosmology and particle physics
Other predictions: Higgs decay into a pair of these stable light scalars

- $m_H < 130$ GeV

Authors: Birkedal, Chacko & Gaillard (2004)
Idea: supersymmetry and the Higgs as a pseudo-Goldstone boson of some extra global symmetry
Techniques: $SU(6)$ grand unification
Other predictions: many supersymmetric particles

- $m_H < 130$ GeV

Authors: Passera, Marciano & Sirlin (2008)
Idea: hypothetical errors in the determination of the hadronic leading-order contribution to cure the present discrepancy between experiment and prediction of the muon $g - 2$
Techniques: quantum corrections by Higgs loops to precision electro-weak data with $m_t = 172.6 \pm 1.4$ GeV

- $m_H < 139$ GeV

Authors: Kaeding & Nandi (1999)
Idea: a non-minimal supersymmetric extension of the standard model
Techniques: gauge mediated supersymmetry breaking and quantum corrections
Other predictions: many supersymmetric particles

- $m_H < 144$ GeV

Authors: Suematsu & Zoupanos (2001)
Idea: a non-minimal supersymmetric extension of the standard model
Techniques: non-universal soft supersymmetry breaking and quantum corrections
Other predictions: many supersymmetric particles

- $m_H < 150$ GeV

Authors: Maloney, Pierce & Wacker (2004)
Idea: supersymmetric extension of the standard model with non-decoupling D-terms
Techniques: soft supersymmetry breaking and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles and new gauge bosons with masses in the TeV range

- $m_H < 150$ GeV

Authors: Moroi & Okada (1992)
Idea: supersymmetric extension of the standard model plus a gauge singlet
Techniques: soft supersymmetry breaking and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles

- $m_H < 150$ GeV

Authors: Carena, Nardini, Quiros & Wagner (2008)
Idea: minimal supersymmetric extension of the standard model with a light stop
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: the light stop

- $m_H < 165$ GeV

Authors: Delgado & Quiros (2000)
Idea: supersymmetric extension of the standard model plus one extra dimension compactified on an orbifold
Techniques: renormalisation group flow with all Higgses in the bulk
Other predictions: many supersymmetric particles

- $m_H < 180$ GeV

Authors: Moroi & Okada (1992)
Idea: supersymmetric extension of the standard model plus extra matter multiplets
Techniques: soft supersymmetry breaking and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles

- $m_H < 200$ GeV

Authors: Espinosa & Quiros (1998)
Idea: supersymmetric extension of the standard model plus extra matter multiplets
Techniques: soft supersymmetry breaking and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles

- $m_H < 230$ GeV

Authors: Bhattacharyya, Majee & Raychaudhuri (2007)
Idea: supersymmetric extension of the standard model plus one extra dimension
Techniques: Kaluza-Klein and radiative corrections

- $m_H < 235$ GeV

Authors: Bhattacharyya, Majee & Ray (2008)
Idea: supersymmetric extension of the standard model plus one extra dimension, Higgs confined to the TeV brane
Techniques: Kaluza-Klein and radiative corrections

- $m_H < 260$ GeV
Authors: Batra, Delgado, Kaplan & Tait (2004)
Idea: supersymmetric extension of the standard model plus a gauge singlet
Techniques: soft supersymmetry breaking and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles and a charged Higgs boson lighter than the neutral one

- $m_H < 350$ GeV
Authors: Batra, Delgado, Kaplan & Tait (2003)
Idea: supersymmetric extension of the standard model plus some new gauge bosons
Techniques: soft supersymmetry breaking, some fine tuning
Other predictions: many supersymmetric particles and new gauge bosons with masses in the TeV range

- $m_H < 400$ GeV
Authors: Litsey & M. Sher (2009)
Idea: minimal supersymmetric extension of the standard model with a fourth generation
Techniques: radiative corrections
Other predictions: the fourth generation at LHC energies and many supersymmetric particles

- $m_H < 446$ GeV
Authors: Huitu, Pandita & Puolamaki (1997)
Idea: supersymmetric extension of the left-right symmetric extension of the standard model
Techniques: soft supersymmetry breaking, 1-loop corrections

- $m_H < 450$ GeV
Authors: Bhattacharyya, Majee & Raychaudhuri (2007)
Idea: supersymmetric extension of the standard model plus two extra dimensions
Techniques: Kaluza-Klein and radiative corrections

- $m_H < 724$ GeV
Authors: Langguth & Montvay (1987)
Idea: lattice gauge theory and triviality of the continuum limit
Techniques: Monte Carlo simulations on 16^4 lattices

- $m_H < 800$ GeV
Authors: Appelquist & Yee (2002)
Idea: Kaluza-Kein with one or two extra comactified dimensions
Techniques: computation of quantum corrections induced by Kaluza-Klein particles on precision electro-weak measurements of the flavour changing process $b \to s + \gamma$ and on

the anomalous magnetic moment of the muon
Other predictions: new dimensions with inverse compactification radius as low as 250 GeV

• $m_H < 880$ GeV
Authors: Jegerlehner, Kalmykov & Veretin (2001)
Idea: Quantum corrections in the relation between $\overline{\text{MS}}$- and pole-masses of the W- and Z-bosons should remain perturbative.
Techniques: 2-loop corrections, asymptotic expansions

• $m_H < 1400$ GeV
Authors: Grzadkowski & Gunion (2007)
Idea: W^+W^- scattering in the Randall-Sundrum model with one extra dimension and two 3-branes should remain perturbatively unitary after inclusion of string/M-theoretic excitations.
Techniques: summation of Kaluza-Klein gravitons

4 A lower bound

• $m_H > 230$ GeV
Authors: Barvinsky, Kamenshchik & Starobinsky (2008)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

5 Final remarks

Our present list contains 78 Higgs-mass predictions. Supersymmetry is behind 23 of them. With the exception of two (250 ± 50 GeV, 255 ± 145 GeV), their central values lie between 120 and 160 GeV. Compactified additional dimensions motivate eight predictions ranging from 117 to 146 GeV. There is one prediction from a superstring inspired landscape: 121 GeV. The embedding of the electro-weak Lie algebra $su(2) \oplus u(1)$ in the superalgebra $su(2|1)$ produces four predictions: 130, 161, 250 and 426 GeV. One prediction, 178 GeV, is motivated by dynamical symmetry breaking via a neutrino condensate. We have listed four predictions from Connes's noncommutative geometry: 170, 203, 241 and 271 GeV. Lattice gauge theories lead to two predictions: 515 and 760 GeV. Eight predictions are based on the (approximate) vanishing of particular terms related to quantum corrections: 154, 155, 200, 210, 309, 374 and 536 GeV. The following three intervals are still free of Higgs-mass predictions: $600 - 739$ GeV, $781 - 1800$ GeV and $2000 - 10^{18}$ GeV.

We have 28 upper bounds for the Higgs mass, 20 of which come from supersymmetry.

Five predictions, one upper and one lower bound come from the recent idea that

inflation is driven by the Higgs scalar together with a strong non-minimal coupling to gravity. The Higgs mass is obtained from fitting the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background.

In this compilation we have only considered numerical pre- and postdictions. Today particle physicists are used to interpret experimental numbers not only in terms of numbers like coupling constants, but also in terms of groups and representations and even in terms of Lagrangians. Only few of the listed models come with constraints on groups, representations and Lagrangians. Supersymmetric models for instance need representations for supersymmetric particles and thereby may be falsified by the LHC. However supersymmetry does not constrain the gauge group nor the Lagrangian. This is different for Connes' noncommutative geometry, which — just as Riemannian geometry — puts severe constraints on the admissible Lagrangians, puts constraints on gauge groups and severe constraints on representations. In particular the Higgs representation of the noncommutative standard model is not chosen but computed to be one colourless isospin doublet. This is certainly its most startling and robust prediction and may lead to its falsification if more than one physical Higgs is found as predicted by any supersymmetric standard model.

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[96] D. Suematsu & G. Zoupanos, *mu-term due to the non-universal supersymmetry breaking and the Higgs mass*, hep-ph/0102096, JHEP 0106 (2001) 038, < 144 GeV

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[98] R. Trostel, *Spinor connection within Weinberg-Salam model and prediction of Higgs mass*, Phys. Lett. B193 (1987) 464, 185.7 GeV

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Higgs-mass predictions

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Abstract

A compilation of Higgs-mass predictions is proposed.

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PCAC-06: 14.80.Bn Standard-model Higgs boson

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1 Introduction

Many physicists hope that the electro-weak Higgs scalar will be observed within a few years at the LHC or at the Tevatron. The literature contains a plethora of predictions or upper limits of the Higgs mass based on many different ideas, models and calculational techniques. Privileged among them is the value $m_H = 150 \pm 36$ GeV currently given by the LEP Electroweak Working Group, because it only relies on precision electro-weak data, non-observation of the Higgs today and the minimal hypothesis that the standard model is correct as it stands. A compilation of all other predictions is attempted here. Some models make additional predictions or postdictions, that are indicated. The point in time separating pre- and postdiction is taken as the time of publication of the model. In this task it is unavoidable that I will miss some references. I beg their authors' pardon and would like to ask them to kindly drop me a mail. Also some of the older post- and predictions might need an update due to changed experimental values of e.g. the top-mass, gauge couplings,... I would be happy to receive and to include such updates.

The predictions are organised in increasing order of the central value of the predicted mass interval. In a second section the upper limits are presented in increasing order as well. A third section contains a single lower limit. Older predictions and limits incompatible with today's experimental lower limit of 114 GeV are not recorded here. However, I should mention the supersymmetric model by Dermíšek & Gunion (2005) with a Higgs mass of 100 GeV. Because of exotic decay channels this model is still compatible with LEP data. Also not recorded are predictions that come with postdictions contradicting present experimental numbers.

The references are in alphabetical order of the first author's last name with chronology as secondary criterion.

2 Predictions

- $m_H = 109 \pm 12$ GeV

Authors: O. Buchmüller *et al.* (2007)
Idea: constrained minimal supersymmetric standard model combined with electro-weak precision data, flavor physics and abundance of cold dark matter
Techniques: multi-parameter fit, renormalisation group equation. The top mass is taken to be $m_t = 170.9 \pm 1.8$ GeV.
Other predictions: many supersymmetric particles

- $m_H = 115.3 \pm 0.1$ GeV

Author: Schücking (2007)
Idea: interpretation of the $SU(2) \times U(1)$ group of the electro-weak forces as symmetry group of the Eguchi-Hanson metric
Techniques: differential geometry and quaternions

- $m_H = 117 \pm 4$ GeV

Authors: Gogoladze, Okada & Shafi (2007)
Idea: Higgs boson as zero mode of gauge boson along a fifth compactified dimension

Techniques: a boundary condition on the Higgs self-coupling at compactification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^8$ GeV

• $m_H = 118$
Authors: Arbuzov, Barbashov, Pervushin, Shuvalov & Zakharov (2008)
Idea: Three peaks of the cosmic microwave background are explained by the decay of primordial Higgs-, W- and Z-bosons into photons.
Techniques: conformal cosmology
Other prediction: $m_H = 216$

• $m_H = 120 \pm 6$ GeV
Authors: Ellis, Nanopoulos, Olive & Santoso (2005)
Idea: supersymmetry
Techniques: minimal supersymmetric extension of the standard model with universal soft supersymmetry-breaking masses
Other predictions: many supersymmetric particles

• $m_H = 120$ GeV
Author: Bogan (2009)
Idea: simple relations between cosmological constant, GUT scale and masses of the electron, inflaton, and Higgs
Techniques: geometric mean

• $m_H = 121 \pm 6$ GeV
Authors: Feldstein, Hall & Watari (2006)
Idea: superstring inspired landscape of vacua and some probability density for the parameters of the Higgs potential
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{19}$ GeV
Postdiction: $m_t = 176 \ \pm 2$ GeV

• $m_H = 121.8 \pm 11$ GeV
Authors: Froggatt & Nielsen (1995)
Idea: two approximately degenerate vacua, one in which we live, the other of Planck energy
Techniques: renormalisation group equations
Postdiction: $m_t = 173 \ \pm 4$ GeV

• $m_H = 122 \pm 10$ GeV
Authors: Djouadi, Heinemeyer, Mondragon & Zoupanos (2004)
Idea: a supersymmetric version of $SU(5)$
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles
Postdictions: $m_t = 174 - 183$ GeV

• $m_H = 123.5 \pm 5.5$ GeV
Authors: Heinemeyer, M. Mondragon & G. Zoupanos (2007)
Idea: a supersymmetric Grand Unified Theory that ca be made all-loop finite
Techniques: renormalisation group flow with $m_t = 170.9$ GeV

Other predictions: supersymmetric particles

- $m_H = 124 \pm 21$ GeV

Authors: Barger, Deshpande, Jiang, Langacker & Li (2007)
Idea: supersymmetry broken at $10^5 - 10^{16}$ GeV and gauge coupling unification at $\Lambda \sim 10^{16} - 10^{17}$ GeV
Techniques: renormalisation group flow up to energies of Λ
Other predictions: new vectorlike fermions with masses in the 200 - 1000 GeV range

- $m_H = 124 \pm 10$ GeV

Authors: Arbuzov, Glinka, Lednicky & Pervushin (2007), version 6
Idea: condensates, conformal cosmology
Techniques: Coleman-Weinberg potential
Other predictions: $m_H = 275 \pm 25$ GeV, version 1

- $m_H = 124.2 \pm 13.2$ GeV

Authors: Codoban, Jurcisin & Kazakov (1999)
Idea: supersymmetry
Techniques: minimal supersymmetric extension of the standard model with non-universal soft supersymmetry-breaking masses
Other predictions: many supersymmetric particles

- $m_H = 125 \pm 4$ GeV

Authors: Gogoladze, Okada & Shafi (2007)
Idea: Higgs boson as zero mode of gauge boson along a fifth compactified dimension
Techniques: a boundary condition on the Higgs self-coupling at compactification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{13} - 10^{14}$ GeV.

- $m_H = 126.3 \pm 2.2$ GeV

Authors: Shaposhnikov & C. Wetterich (2009)
Idea: Assume that gravity is asymptotically safe, that there are no intermediate energy scales between the Fermi and Planck scales, that the gravity induced anomalous dimension of the Higgs selfcoupling is positive.
Techniques: renormalisation group flow with $m_t = 171.2$ GeV

- $m_H = 127.5 \pm 7.5$ GeV

Authors: Chankowski, Falkowski, Pokorski & Wagner (2004)
Idea: supersymmetry and the Higgs as a pseudo-Goldstone boson of some extra global symmetry
Techniques: smaller fine-tuning than in the minimal supersymmetric extension of the standard model. The computation of the Higgs mass depends on the top mass taken to be $m_t = 178 \pm 4.3$ GeV.
Other predictions: many supersymmetric particles and an additional Z-boson with a mass of 3 TeV

- $m_H = 129.6$ GeV

Authors: X. Calmet & H. Fritzsch (2001)
Idea: confining $SU(2)$ and a 'complementarity principle'
Techniques: 1-loop corrections

• $m_H = 130 \pm 6$ GeV
Authors: Dae Sung Hwang, Chang-Yeong Lee & Ne'eman (1996)
Idea: embedding of the electro-weak Lie algebra $su(2) \oplus u(1)$ in the superalgebra $su(2|1)$
Techniques: renormalisation group flow
Postdictions: $\sin^2 \theta_w = 0.229 \pm 0.005$

• $m_H = 131 \pm 10$ GeV
Authors: Gogoladze, Li, Senoguz & Shafi (2006)
Idea: 7 dimensional orbifold with $SU(7)$ grand unification and split supersymmetry
Techniques: a boundary condition on the Higgs self-coupling at unification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: $m_H = 146 \pm 8$ GeV

• $m_H = 134 \pm 9$ GeV
Authors: Ni, Lou, Lu & Yang (1998)
Idea: a Gaußian effective potential
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{15}$ GeV

• $m_H = 135 \pm 6$ GeV
Authors: Gogoladze, Li & Shafi (2006)
Idea: 7 dimensional $N = 1$ supersymmetric orbifold with $SU(7)$ grand unification
Techniques: a boundary condition on the Higgs self-coupling at unification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: $m_H = 144 \pm 4$ GeV

• $m_H = 135 \pm 15$ GeV
Authors: Arkani-Hamed & Dimopoulos (2004)
Idea: split supersymmetry
Techniques: fine tuning and renormalisation group flow up to energies of 10^{16} GeV

• $m_H = 137 \pm 23$ GeV
Authors: Medina, Shah & Wagner (2007)
Idea: a warped fifth dimension and an extension of the electro-weak gauge symmetry to $SO(5) \times U(1)$ in the bulk, broken at the boundaries
Techniques: Coleman-Weinberg potential

• $m_H = 140 \pm 10$ GeV
Authors: Babu, Gogoladze, Rehman & Shafi (2008)
Idea: minimal supersymmetric extension of the standard model plus complete vectorlike multiplets of grand unified groups
Techniques: some fine tuning and renormalisation group flow up to energies of 10^{16} GeV. The top mass is taken to be $m_t = 172.6 \pm 1.4$ GeV.
Other predictions: many supersymmetric particles

• $m_H = 141 \pm 2$ GeV
Authors: Hall & Y. Nomura (2009)
Idea: minimal supersymmetric extension of the standard model plus supersymmetry breaking at very high scale, motivated from a multiverse

Techniques: huge fine tuning and 2-loop corrections with a top mass of 173.1 GeV
Other predictions: no supersymmetric particles

- $m_H = 143 \pm 37$ GeV
Authors: Cabibbo, Maiani, Parisi & Petronzio (1979)
Idea: the big desert: no new particles besides the Higgs and validity of perturbative quantum field theory up to the Planck scale
Techniques: renormalisation group flow up to energies of 10^{19} GeV. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 171.5 \pm 2$ GeV.

- $m_H = 143.2 \pm 28.8$ GeV
Authors: Gogoladze, Okada & Shafi (2007.2)
Idea: 2 extra dimensions compactified on an orbifold
Techniques: a boundary condition on the Higgs self-coupling at compactification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{19}$ GeV.

- $m_H = 144 \pm 4$ GeV
Authors: Gogoladze, Li & Shafi (2006)
Idea: 7 dimensional $N = 1$ supersymmetric orbifold with $SU(7)$ grand unification
Techniques: a boundary condition on the Higgs self-coupling at unification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV.
Other predictions: $m_H = 135 \pm 6$ GeV

- $m_H = 145 \pm 7$ GeV
Author: Liu (2005)
Idea: supersymmetry broken at 10^{11} GeV and a $\mathbb{Z}_3$ symmetry among generations
Techniques: radiative corrections

- $m_H = 146 \pm 8$ GeV
Authors: Gogoladze, Li, Senoguz & Shafi (2006)
Idea: 7 dimensional orbifold with $SU(7)$ grand unification and split supersymmetry
Techniques: a boundary condition on the Higgs self-coupling at unification scale Λ and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV.
Other predictions: $m_H = 131 \pm 10$ GeV

- $m_H = 146 \pm 19$ GeV
Authors: Barger, Jiang, Langacker & Li (2005)
Idea: supersymmetry broken at high scale and gauge coupling unification at $\Lambda \sim 10^{16} - 10^{17}$ GeV
Techniques: renormalisation group flow up to energies of Λ

- $m_H = 148.1 \pm 10.7$ GeV
Author: Popa (2009)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action with $m_t = 171.3$ GeV and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

- $\underline{m_H = 150 \pm 36 \text{ GeV}}$

Authors: The LEP Electroweak Working Group
Idea: non-observation of the Higgs and quantum corrections by Higgs loops to precision electro-weak data
Techniques: experiment and quantum field theory

- $m_H = 150 \pm 10$ GeV

Authors: Barger, Chiang, Jiang & Li (2004)
Idea: supersymmetry broken at 10^{11} GeV and Peccei-Quinn symmetry
Techniques: radiative corrections

- $m_H = 150 \pm 20$ GeV

Authors: Arvanitaki, Davis, Graham & Wacker (2004)
Idea: split supersymmetry
Techniques: fine tuning and renormalisation group flow up to energies of 10^{16} GeV

- $m_H = 150 \pm 50$ GeV

Authors: Bai, Fan & Han (2007)
Idea: supersymmetry and a long-lived metastable supersymmetry breaking vacuum
Techniques: little Higgs mechanism, 1-loop corrections
Other predictions: many supersymmetric particles plus new gauge bosons and electroweak triplets at 1 TeV

- $m_H = 150 \pm 24$ GeV

Authors: Shaposhnikov & C. Wetterich (2009)
Idea: Assume that gravity is asymptotically safe, that there are no intermediate energy scales between the Fermi and Planck scales.
Techniques: renormalisation group flow with $m_t = 171.2$ GeV

- $m_H = 153 \pm 3$ GeV

Author: Okumura (1997)
Idea: a vague variant of the Connes-Lott model
Techniques: 2-loop renormalisation group flow up to energies of 10^{13} GeV. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 171.5 \pm 2$ GeV.

- $m_H = 154 \pm 6$ GeV

Authors: Ananthanarayan & Pasupathy (2001)
Idea: weak dependence of the ratio between Higgs self-coupling and top Yukawa coupling squared on renormalisation scale
Techniques: 1- and 2-loop corrections

- $m_H = 154 \pm 37$ GeV

Authors: Gogoladze, He & Shafi (2010)
Idea: Vectorlike isospin doublets of quarks with masses of several 100 GeV are added to the standard model to achieve gauge unification at $3 \cdot 10^{16}$ GeV. Assuming the validity of perturbative quantum field theory up to this energy constrains the Higgs-mass as in Cabibbo, Maiani, Parisi & Petronzio (1979).
Techniques: renormalisation group flow
Other predictions: these new vectorlike quarks

- $m_H = 154.4 \pm 0.5$ GeV

Author: Beck (2001)
Idea: 'chaotic strings' describing the dynamics of vacuum fluctuations underlying dark energy
Techniques: stochastic quantization
Postdictions: all fermion and gauge bosons masses, all gauge couplings

- $m_H = 155 \pm 8$ GeV

Authors: Schrempp & Schrempp (1993)
Idea: A strongly infrared attractive line in the $m_t - m_H$ plane is found.
Techniques: 1-loop renormalization group equations

- $m_H = 160 \pm 8$ GeV

Authors: Roepstorff & Vehns (2000)
Idea: combining gauge and Yukawa interactions in one generalised Dirac operator
Techniques: superconnections
Postdictions: $m_t = 160 \pm 8$ GeV

- $m_H = 160 \pm 20$ GeV

Authors: Langacker, Paz, Wang & Yavin (2007)
Idea: an extension of the minimal supersymmetric extension of the standard model plus a hidden sector plus a Z' mediating supersymmetry breaking by couplings to the hidden sector
Techniques: 2-loop corrections up to energies of $10^7 - 10^{11}$ GeV
Other predictions: many supersymmetric particles

- $m_H = 160 \pm 24.5$ GeV

Authors: Barvinsky, Kamenshchik, Kiefer, Starobinsky & Steinwachs (2009)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action to 1-loop with $m_t = 171$ GeV and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

- $m_H = 160 \pm 30$ GeV

Author: Bezrukov (2008)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

- $m_H = 160 \pm 34$ GeV

Authors: Bezrukov & Shaposhnikov (2009)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action to 2-loop with $m_t = 171.2$ GeV and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

- $m_H = 160.7 \pm 24$ GeV

Authors: Bezrukov, Magnin & Shaposhnikov (2008)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action to 1-loop with $m_t = 171$ GeV and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

- $m_H = 160.9 \pm 0.1$ GeV

Author: Ne'eman (1986)
Idea: embedding of the electro-weak Lie algebra $su(2) \oplus u(1)$ in the superalgebra $su(2|1)$
Techniques: classical field theory
Postdictions: $\sin^2 \theta_w = 1/4$

- $m_H = 161.8033989$ GeV

Author: El Naschie (2005)
Idea: E-infinity theory
Techniques: ?

- $m_H = 170 \pm 10$ GeV

Authors: Chamseddine & Connes (1996)
Idea: derivation of the standard model from gravity by generalising Riemannian to non-commutative geometry
Techniques: operator algebras, heat-kernel expansion and renormalisation group flow up to energies of $\Lambda \sim 10^{13} - 10^{17}$ GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 170.9 \pm 2.5$ GeV.
Other predictions: conceptual uncertainty in proper time measurements of $\Delta\tau \sim \hbar/\Lambda = 10^{-41} - 10^{-37}$ s
Postdictions: $m_W^2/(\cos^2\theta_w\, m_z^2) = 1$, gluons must be massless and must have pure vector-couplings, $m_t < 186.3$ GeV.

- $m_H = 177.5 \pm 7.5$ GeV

Authors: Antusch, Kersten, Lindner & Ratz (2002)
Idea: the Higgs as a composite particle from neutrino condensation
Techniques: seesaw mechanism, gap equation, renormalisation group flow up to the condensation scale $\Lambda = 10^{16}$ GeV

- $m_H = 182 \pm 4$ GeV

Author: Namsrai (1996)
Idea: Higgs mass from space-time curvature
Techniques: general relativity and solitons

- $m_H = 185 \pm 5$ GeV

Author: Schrempp & Schrempp (1986)
Idea: A largely unspecified strong interaction is assumed to soften the elastic scattering of longitudinally polarised W bosons.
Techniques: a superconvergence sum rule

- $m_H = 185.7 \pm 0.1$ GeV

Author: Trostel (1987)
Idea: a geometrisation of the Yukawa couplings
Techniques: spinor connections

• $m_H = 186 \pm 8$ GeV
Authors: Tolksdorf & Thumstädter (2006)
Idea: differential geometric unification of general relativity and the standard model
Techniques: generalised Dirac operators, heat kernel expansion and renormalisation group flow up to energies of $\Lambda \sim 10^{10}$ GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 174 \pm 3$ GeV.

• $m_H = 194 \pm 80$ GeV
Authors: García-Bellido, Figueroa & Rubio (2008)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background, lower limit from non-observation of the Higgs at LEP

• $m_H = 197.2 \pm 124.8$ GeV
Authors: Froggatt, Laperashvili, Nevzorov, Nielsen & Sher (2006)
Idea: non-supersymmetric extension of the standard model with two Higgs doublets and the multiple point principle
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^4 - 10^{19}$ GeV
Other predictions: additional neutral and charged scalars with masses larger than 202.4 GeV

• $m_H = 200 \pm 20$ GeV
Authors: Froggatt, Nevzorov, Nielsen & Thompson (2008)
Idea: non-supersymmetric extension of the standard model with two Higgs doublets and the multiple point principle
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^5$ GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 171.4 \pm 2.1$ GeV.
Other predictions: enhanced top-Higgs coupling

• $m_H = 200 \pm 50$ GeV
Author: Cvetič (1995)
Idea: It is supposed that the 1-loop contributions of the scalar self-interactions to the effective potential are distinctly less than those of the Yukawa couplings of the top.
Techniques: 1-loop corrections with cut-off at 10^3 GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 180$ GeV.

• $m_H = 203 \pm 2.2$ GeV
Author: Squellari & Stephan (2007)
Idea: extension of Chamseddine and Connes' spectral action to include three vectorlike isospin doublets
Techniques: operator algebras, heat-kernel expansion and renormalisation group flow up to $\Lambda = 3 - 5 \cdot 10^7$ GeV. The computation of the Higgs mass depends on the top mass

taken to be $m_t = 170.9 \pm 2.6$ GeV.
Other predictions: six new leptons with masses of $10 - 550$ TeV, conceptual uncertainty in proper time measurements of $\Delta\tau \sim \hbar/\Lambda \sim 10^{-32}$ s
Postdictions: $m_W^2/(\cos^2\theta_w\, m_z^2) = 1$, gluons must be massless and must have pure vector-couplings.

- $m_H = 210 \pm 10$ GeV

Authors: Andrianov & Romanenko (1995)
Idea: modified Veltman condition and fixed point in running of Yukawa coupling
Techniques: renormalisation group flow up to energies of 10^{16} GeV
Postdictions: $m_t = 175 \pm 5$ GeV

- $m_H = 216$

Authors: Arbuzov, Barbashov, Pervushin, Shuvalov & Zakharov (2008)
Idea: Three peaks of the cosmic microwave background are explained by the decay of primordial Higgs-, W- and Z-bosons into photons.
Techniques: conformal cosmology
Other prediction: $m_H = 118$

- $m_H = 226 \pm 50$ GeV

Authors: Aranda, Díaz-Cruz & Rosado (2005)
Idea: unification of the weak gauge couplings at intermediate energy Λ and linear or quadratic relation of these to the Higgs self-coupling
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{13}$ GeV

- $m_H = 241.2 \pm 1.6$ GeV

Author: Stephan (2007)
Idea: extension of Chamseddine and Connes' spectral action to $SU(4)\times SU(3)\times SU(2)\times U(1)$
Techniques: operator algebras, heat-kernel expansion and renormalisation group flow up to $\Lambda = 2\cdot 10^4$ GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 170.9 \pm 2.6$ GeV.
Other predictions: confined $SU(4)$ singlets in the TeV range, conceptual uncertainty in proper time measurements of $\Delta\tau \sim \hbar/\Lambda = 3.3\cdot 10^{-29}$ s
Postdictions: $m_W^2/(\cos^2\theta_w\, m_z^2) = 1$, gluons must be massless and must have pure vector-couplings.

- $m_H = 250 \pm 50$ GeV

Authors: Barbieri, Hall, Nomura & Rychkov (2006)
Idea: extending the minimal supersymmetric extension of the standard model by adding a chiral singlet with a superpotential interaction with the Higgs doublets
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10$ TeV

- $m_H \approx 250$ GeV

Authors: Ne'eman & Thierry Mieg (1982)
Idea: embedding of the electro-weak Lie algebra $su(2)\oplus u(1)$ in the superalgebra $su(2|1)$
Techniques: classical field theory
Postdictions: $\sin^2\theta_w = 1/4$

- $m_H = 255 \pm 145$ GeV

Author: Mahbubani (2004)
Idea: split supersymmetry
Techniques: fine tuning and renormalisation group flow up to energies of 10^{16} GeV

- $m_H = 271 \pm 5$ GeV

Authors: Connes & Lott (1991)
Idea: derivation of the Higgs sector of the standard model from the Yang-Mills sector by generalising Euclidean to noncommutative geometry
Techniques: operator algebras. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 170.9 \pm 2.5$ GeV.
Postdictions: $m_W^2/(\cos^2\theta_w\, m_z^2) = 1$, gluons must be massless and must have pure vector-couplings, $m_t > 139.3$ GeV, $\sin^2\theta_w < 0.543$.

- $m_H = 275 \pm 25$ GeV

Authors: Arbuzov, Glinka, Lednicky & Pervushin (2007), version 1
Idea: condensates, conformal cosmology
Techniques: Coleman-Weinberg potential
Other predictions: $m_H = 124 \pm 10$ GeV, version 6

- $m_H = 308.6 \pm 0.3$ GeV

Authors: López Castro & Pestieau (1995)
Idea: absence of quadratic and logarithmic divergences in the top mass
Techniques: 1-loop quantum corrections
Other predictions: $m_t = 170.5 \pm 0.3$ GeV

- $m_H = 309 \pm 6$ GeV

Authors: Decker & Pestieau (1979), also Veltman (1981)
Idea: absence of quadratic 1-loop divergences
Techniques: dimensional reduction. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 170.9 \pm 2.5$ GeV.

- $m_H = 317 \pm 80$ GeV

Authors: Bazzocchi & Fabbrichesi (2004)
Idea: Flavour symmetry broken together with electro-weak symmetry, little Higgs
Techniques: Coleman-Weinberg effective potential
Other predictions: Many new particles including a charged scalar with mass 560 ± 192 GeV

- $m_H = 374 \pm 6$ GeV

Author: Xiao-Gang He (2002)
Idea: no dependence of total vacuum energy (Casimir plus minimum of Higgs potential) on renormalisation scale
Techniques: Casimir effect and quantum corrections. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 170.9 \pm 2.5$ GeV.

- $m_H = 426$ GeV

Author: Fairlie (1979)

Idea: embedding of the electro-weak Lie algebra $su(2) \oplus u(1)$ in the superalgebra $su(2|1)$
Techniques: classical field theory
Postdictions: $\sin^2 \theta_w = 1/4$

- $m_H = 500 \pm 100$ GeV

Authors: Barbieri, Hall & Rychkov (2006)
Idea: adding an inert isospin doublet of pseudo scalars
Techniques: renormalisation group flow up to energies of $\Lambda \sim 1.5$ TeV
Other predictions: pseudo scalars with masses between 60 GeV and 1 TeV leading in particular to an increased width of the ordinary Higgs scalar

- $m_H = 515 \pm 64$ GeV

Authors: Langguth, Montvay & Weisz (1986)
Idea: lattice gauge theory and triviality of the continuum limit
Techniques: Monte Carlo simulations on 12^4 lattices

- $m_H = 536 \pm 10$ GeV

Authors: Babic, Guberina, Horvat & Stefancic (2001)
Idea: no dependence of cosmological constant on renormalisation scale
Techniques: quantum corrections. The computation of the Higgs mass depends on the top mass taken here to be $m_t = 170.9 \pm 2.5$ GeV.

- $m_H = 760 \pm 21$ GeV

Authors: Cea, Consoli & Cosmai (2003)
Idea: lattice gauge theory and triviality of the continuum limit
Techniques: extrapolation from Ising limit

- $m_H = 1900 \pm 100$ GeV

Authors: Ibañez-Meier & Stevenson (1992)
Idea: vanishing bare Higgs mass and 1-loop effective potential
Techniques: autonomous renormalisation

- $m_H = 10^{18}$ GeV

Authors: Batakis & Kehagias (1991)
Idea: Higgs field as massive excitation of the vacuum configuration of a sigma field coupled to gravity
Techniques: non-linear sigma models

3 Upper bounds

- $m_H < 123$ GeV

Authors: Belyaev, Dar, Gogoladze, Mustafayev & Shafi (2007)
Idea: constrained minimal supersymmetric standard model combined with supersymmetry constraints from colliders and low energy physics and constraints on dark matter
Techniques: renormalisation group equation. The top mass is taken to be $m_t = 171.4$ GeV.
Other predictions: many supersymmetric particles

- $m_H < 125$ GeV

Authors: Froggatt, Nevzorov, Nielsen & Thompson (2008)
Idea: non-supersymmetric extension of the standard model with two Higgs doublets and the multiple point principle
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{10}$ GeV. The computation of the Higgs mass depends on the top mass taken to be $m_t = 171.4 \pm 2.1$ GeV.

- $m_H < 125$ GeV

Authors: Babu, Gogoladze, Rehman & Shafi (2008)
Idea: minimal supersymmetric extension of the standard model plus complete vectorlike multiplets of grand unified groups
Techniques: some fine tuning and renormalisation group flow up to energies of 10^{16} GeV. The top mass is taken to be $m_t = 172.6 \pm 1.4$ GeV.
Other predictions: many supersymmetric particles

- $m_H < 126$ GeV

Authors: De Simone, Hertzberg & Wilczek (2008)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action to 2-loop with $m_t = 171.2$ GeV and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

- $m_H < 127$ GeV

Authors: Carena, Nardini, Quiros & Wagner (2008)
Idea: minimal supersymmetric extension of the standard model with a light stop and electro-weak baryo-genesis
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: the light stop with mass < 120 GeV

- $m_H < 130$ GeV

Authors: Okada, Yamaguchi & Yanagida (1991)
Idea: minimal supersymmetric extension of the standard model
Techniques: soft supersymmetry breaking at 1 TeV and quantum corrections
Other predictions: many supersymmetric particles

- $m_H < 130$ GeV

Authors: Bento, Bertolami & Rosenfeld (2001)
Idea: introduction of a stable gauge singlet scalar of mass around 1 GeV coupled to the Higgs, playing the role of cold dark matter and solving problems with small scale structure formation
Techniques: phenomenological constraints from cosmology and particle physics
Other predictions: Higgs decay into a pair of these stable light scalars

- $m_H < 130$ GeV

Authors: Birkedal, Chacko & Gaillard (2004)
Idea: supersymmetry and the Higgs as a pseudo-Goldstone boson of some extra global symmetry

Techniques: $SU(6)$ grand unification
Other predictions: many supersymmetric particles

- $m_H < 130$ GeV
Authors: Passera, Marciano & Sirlin (2008)
Idea: hypothetical errors in the determination of the hadronic leading-order contribution to cure the present discrepancy between experiment and prediction of the muon $g-2$
Techniques: quantum corrections by Higgs loops to precision electro-weak data with $m_t = 172.6 \pm 1.4$ GeV

- $m_H < 139$ GeV
Authors: Kaeding & Nandi (1999)
Idea: a non-minimal supersymmetric extension of the standard model
Techniques: gauge mediated supersymmetry breaking and quantum corrections
Other predictions: many supersymmetric particles

- $m_H < 144$ GeV
Authors: Suematsu & Zoupanos (2001)
Idea: a non-minimal supersymmetric extension of the standard model
Techniques: non-universal soft supersymmetry breaking and quantum corrections
Other predictions: many supersymmetric particles

- $m_H < 150$ GeV
Authors: Maloney, Pierce & Wacker (2004)
Idea: supersymmetric extension of the standard model with non-decoupling D-terms
Techniques: soft supersymmetry breaking and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles and new gauge bosons with masses in the TeV range

- $m_H < 150$ GeV
Authors: Moroi & Okada (1992)
Idea: supersymmetric extension of the standard model plus a gauge singlet
Techniques: soft supersymmetry breaking and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles

- $m_H < 150$ GeV
Authors: Carena, Nardini, Quiros & Wagner (2008)
Idea: minimal supersymmetric extension of the standard model with a light stop
Techniques: renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: the light stop

- $m_H < 165$ GeV
Authors: Delgado & Quiros (2000)
Idea: supersymmetric extension of the standard model plus one extra dimension compactified on an orbifold
Techniques: renormalisation group flow with all Higgses in the bulk

Other predictions: many supersymmetric particles

- $m_H < 180$ GeV

Authors: Moroi & Okada (1992)
Idea: supersymmetric extension of the standard model plus extra matter multiplets
Techniques: soft supersymmetry breaking and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles

- $m_H < 200$ GeV

Authors: Espinosa & Quiros (1998)
Idea: supersymmetric extension of the standard model plus extra matter multiplets
Techniques: soft supersymmetry breaking and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles

- $m_H < 230$ GeV

Authors: Bhattacharyya, Majee & Raychaudhuri (2007)
Idea: supersymmetric extension of the standard model plus one extra dimension
Techniques: Kaluza-Klein and radiative corrections

- $m_H < 235$ GeV

Authors: Bhattacharyya, Majee & Ray (2008)
Idea: supersymmetric extension of the standard model plus one extra dimension, Higgs confined to the TeV brane
Techniques: Kaluza-Klein and radiative corrections

- $m_H < 260$ GeV

Authors: Batra, Delgado, Kaplan & Tait (2004)
Idea: supersymmetric extension of the standard model plus a gauge singlet
Techniques: soft supersymmetry breaking and renormalisation group flow up to energies of $\Lambda \sim 10^{16}$ GeV
Other predictions: many supersymmetric particles and a charged Higgs boson lighter than the neutral one

- $m_H < 280$ GeV

Authors: Ham, Shim, Kim & Oh (2010)
Idea: minimal supersymmetric extension of the standard model plus a few vectorlike quarks of masses in the $300 - 550$ GeV range
Techniques: renormalisation group flow to one-loop
Other predictions: many supersymmetric particles

- $m_H < 300$ GeV

Authors: Babu, Gogoladze & Kolda (2004)
Idea: minimal supersymmetric extension of the standard model plus complete vectorlike multiplets of grand unified groups
Techniques: renormalisation group flow up to energies of 10^{16} GeV
Other predictions: many supersymmetric particles

- $m_H < 350$ GeV

Authors: Batra, Delgado, Kaplan & Tait (2003)
Idea: supersymmetric extension of the standard model plus some new gauge bosons
Techniques: soft supersymmetry breaking, some fine tuning
Other predictions: many supersymmetric particles and new gauge bosons with masses in the TeV range

- $m_H < 400$ GeV

Authors: Litsey & M. Sher (2009)
Idea: minimal supersymmetric extension of the standard model with a fourth generation
Techniques: radiative corrections
Other predictions: the fourth generation at LHC energies and many supersymmetric particles

- $m_H < 446$ GeV

Authors: Huitu, Pandita & Puolamaki (1997)
Idea: supersymmetric extension of the left-right symmetric extension of the standard model
Techniques: soft supersymmetry breaking, 1-loop corrections

- $m_H < 450$ GeV

Authors: Bhattacharyya, Majee & Raychaudhuri (2007)
Idea: supersymmetric extension of the standard model plus two extra dimensions
Techniques: Kaluza-Klein and radiative corrections

- $m_H < 724$ GeV

Authors: Langguth & Montvay (1987)
Idea: lattice gauge theory and triviality of the continuum limit
Techniques: Monte Carlo simulations on 16^4 lattices

- $m_H < 800$ GeV

Authors: Appelquist & Yee (2002)
Idea: Kaluza-Kein with one or two extra comactified dimensions
Techniques: computation of quantum corrections induced by Kaluza-Klein particles on precision electro-weak measurements of the flavour changing process $b \to s + \gamma$ and on the anomalous magnetic moment of the muon
Other predictions: new dimensions with inverse compactification radius as low as 250 GeV

- $m_H < 880$ GeV

Authors: Jegerlehner, Kalmykov & Veretin (2001)
Idea: Quantum corrections in the relation between $\overline{\mathrm{MS}}$- and pole-masses of the W- and Z-bosons should remain perturbative.
Techniques: 2-loop corrections, asymptotic expansions

- $m_H < 1008$ GeV

Authors: Lee, Quigg & Thacker (1977)
Idea: unitarity requirement

Techniques: partial-wave amplitude of elastic boson scattering in lowest order of perturbation to be bounded by unity

- $m_H < 1020$ GeV

Authors: Dicus & Mathur (1973)
Idea: unitarity requirement
Techniques: partial-wave amplitude of $Z_L Z_L \to Z_L Z_L$ in lowest order of perturbation to be bounded by unity

- $m_H < 1400$ GeV

Authors: Grzadkowski & Gunion (2007)
Idea: W^+W^- scattering in the Randall-Sundrum model with one extra dimension and two 3-branes should remain perturbatively unitary after inclusion of string/M-theoretic excitations.
Techniques: summation of Kaluza-Klein gravitons

4 A lower bound

- $m_H > 230$ GeV

Authors: Barvinsky, Kamenshchik & Starobinsky (2008)
Idea: Let the Higgs be the inflaton by adding a strong, non-minimal coupling $\varphi^2 R$ of the scalar to gravity.
Techniques: effective action and its confrontation with the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background

5 Final remarks

Our present list contains 81 Higgs-mass predictions. Supersymmetry is behind 23 of them. With the exception of two (250 $\pm$ 50 GeV, 255 $\pm$ 145 GeV), their central values lie between 120 and 160 GeV. Compactified additional dimensions motivate eight predictions ranging from 117 to 146 GeV. There are two superstring inspired predictions: 121 and 154.4 GeV. The embedding of the electro-weak Lie algebra $su(2) \oplus u(1)$ in the superalgebra $su(2|1)$ produces four predictions: 130, 161, 250 and 426 GeV. One prediction, 178 GeV, is motivated by dynamical symmetry breaking via a neutrino condensate. We have listed four predictions from Connes's noncommutative geometry: 170, 203, 241 and 271 GeV. Lattice gauge theories lead to two predictions: 515 and 760 GeV. Eight predictions are based on the (approximate) vanishing of particular terms related to quantum corrections: 154, 155, 200, 210, 309, 374 and 536 GeV.

We have 32 upper bounds for the Higgs mass, 22 of which come from supersymmetry.

Five predictions, one upper and one lower bound come from the recent idea that inflation is driven by the Higgs scalar together with a strong non-minimal coupling to

gravity. The Higgs mass is obtained from fitting the observed spectral index and tensor-to-scalar ratio of the Cosmic Microwave Background.

The oldest entry is: $m_H < 1020$ GeV by Dicus & Mathur (1973).

The most precise prediction is: $m_H = 161.8033989$ GeV by El Naschie (2005).

The highest prediction is: $m_H = 10^{18}$ GeV by Batakis & Kehagias (1991).

The highest number of predictions by a single co-author, Gogoladze, is 12.

The following three intervals are still free of Higgs-mass predictions:

$600 - 739$ GeV, $781 - 1800$ GeV and $2000 - 10^{18}$ GeV.

In this compilation we have only considered numerical post- and predictions. Today particle physicists are used to interpret experimental numbers not only in terms of numbers like coupling constants, but also in terms of groups and representations and even in terms of Lagrangians. Only few of the listed models come with constraints on groups, representations and Lagrangians. Supersymmetric models for instance need representations for supersymmetric particles and thereby may be falsified by the LHC. However supersymmetry does not constrain the gauge group nor the Lagrangian. This is different for Connes' noncommutative geometry, which — just as Riemannian geometry — puts severe constraints on the admissible Lagrangians, puts constraints on gauge groups and severe constraints on representations. In particular the Higgs representation of the noncommutative standard model is not chosen but computed to be one colourless isospin doublet. This is certainly its most startling and robust prediction and may lead to its falsification if more than one physical Higgs is found as predicted by any supersymmetric standard model.

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